JP2001-216518A Engligh Translation * 36p.

CLAIMS

[Claim(s)]

[Claim 1]While an outline of a face and component parts of a face are included, template matching which asks for a matching degree of several face templates which differ in the direction of a light source irradiated by direction of a kind of face and a face and face at least, and a face picture containing a person's face is performed, A matching method acquiring information about the direction of a light source irradiated by direction of a face and this face in a face area which determines a face template with this highest matching degree, and where this matching degree contains a face on said face picture based on the highest face template.

[Claim 2]The matching method according to claim 1 setting up a field of a prescribed range which includes said face area in said face picture as a face area candidate, and performing said template matching in this face area candidate.

[Claim 3]The matching method according to claim 1 or 2 characterized by coming to create said two or more face templates beforehand.

[Claim 4]It is created when said two or more face templates change direction of a face in two or more standard templates beforehand created according to a kind of said face, and the direction of a light source, The matching method according to claim 1 or 2 performing said template matching acquiring a face template by which direction of said face and the direction of a light source were changed.

[Claim 5]A matching method of four given in any 1 paragraph from claim 1 performing said template matching by asking for a matching degree hierarchical about said two or more face templates.

[Claim 6]Based on information about direction of said face and the direction of a light

source which were acquired from claim 1 by a matching method of five given in any 1 paragraph, An image processing method searching for beige concentration distribution in said face area, defining beige space in said face picture based on this concentration distribution, and extracting a field corresponding to said beige space in said face picture as said face area.

[Claim 7]The image processing method according to claim 6 performing predetermined image processing to said complexion range.

[Claim 8]A matching device comprising:

While an outline of a face and component parts of a face are included, template matching which asks for a matching degree of several face templates which differ in the direction of a light source irradiated by direction of a kind of face and a face and face at least, and a face picture containing a person's face is performed, A template matching means which determines a face template with this highest matching degree. An information acquisition means which acquires information about the direction of a light source irradiated by direction of a face and this face in a face area where this matching degree contains a face on said face picture based on the highest face template.

[Claim 9]The matching device according to claim 8 which is further provided with an area setting means which sets up a field of a prescribed range which includes said face area in said face picture as a face area candidate, and is characterized by said template matching means being a means to perform said template matching in said face area candidate.

[Claim 10]The matching device according to claim 8 or 9 having further a template memory measure which memorizes said two or more face templates.

[Claim 11]A standard template memory measure which memorizes two or more standard templates beforehand created according to a kind of said face, It has further a template preparing means which creates said two or more face templates by changing direction of a face in said two or more standard templates, and the direction of a light source, The matching device according to claim 8 or 9, wherein said template matching means is a means to perform said template matching acquiring a face template from which direction of said face and the direction of a light source which were created by this template preparing means differ.

[Claim 12]A matching device of 11 given in any 1 paragraph from claim 8, wherein said template matching means is a means to perform said template matching by asking for a matching degree hierarchical about said two or more face templates.

[Claim 13]An image processing device comprising:
A means to search for beige concentration distribution in said face area based on information about direction of said face and the direction of a light source which were acquired from claim 8 by a matching device of 12 given in any 1 paragraph.
A means to define beige space in said face picture based on this concentration distribution.
A means to extract a field corresponding to said beige space in said face picture as said face area.

[Claim 14]The image processing device according to claim 13 having further a means to perform predetermined image processing to said complexion range.
[Claim 15]A recording medium characterized by comprising the following which recorded a program for making a computer perform a matching method and in which computer reading is possible.
While an outline of a face and component parts of a face are included, template matching which asks for a matching degree of several face templates which differ in the direction of a light source irradiated by direction of a kind of face and a face and face at least, and a face picture containing a person's face is performed, A procedure of determining a face template with this highest matching degree.
A procedure which acquires information about the direction of a light source irradiated by direction of a face and this face in a face area where this matching degree contains a face on said face picture based on the highest face template.

[Claim 16]A procedure of having further the procedure of setting up a field of a prescribed range which includes said face area in said face picture as a face area candidate, and performing said template matching, A recording medium being the procedure of performing said template matching in this face area candidate and in which the computer reading according to claim 15 is possible.
[Claim 17]A recording medium which is characterized by coming to create said two or more face templates beforehand and in which the computer reading according to claim 15 or 16 is possible.
[Claim 18]It has further a procedure created by changing direction of a face in two or more standard templates beforehand created in said two or more face templates according to a kind of said face, and the direction of a light source, A recording medium in which the computer reading according to claim 15 or 16 is possible, wherein a procedure of performing said template matching is a procedure of performing said

template matching acquiring a face template by which direction of said face and the direction of a light source were changed.
[Claim 19]A recording medium which can computer read an any 1 paragraph statement of 18 from claim 15, wherein a procedure of performing said template matching is a procedure of performing said template matching by asking for a matching degree hierarchical about said two or more face templates.
[Claim 20]A recording medium in which computer reading is possible, comprising:
A procedure of searching for beige concentration distribution in said face area based on information about direction of said face and the direction of a light source which were acquired from claim 1 by a matching method of five given in any 1 paragraph.
A procedure of defining beige space in said face picture based on this concentration distribution.
A procedure of extracting a field corresponding to said beige space in said face picture as said face area.

[Claim 21]A recording medium having further the procedure of performing predetermined image processing to said complexion range and in which the computer reading according to claim 20 is possible.

[Translation done.]
DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]A matching method and a device which perform template matching of the picture and template in which this invention contains a person's face. It is related with the recording medium which recorded the program for making a computer perform the image processing method, the device, matching method, and image processing method using these methods and devices and in which computer reading is possible.
[0002]
[Description of the Prior Art]In pictures, such as a photograph obtained by photoing a person image using a negative film, a reversal film, etc., the part which attracts attention most is a person's face. Therefore, in order to improve the vanity of a picture, it is necessary to perform image processing to a picture so that it may

become a color with a person's proper face, concentration, and gradation. In order to perform image processing so that it may become a color with a person's proper face, concentration, and gradation on the other hand, it is necessary to extract a person's face area from a picture appropriately. For this reason, extract the candidate of a complexion range out of the picture which includes a person, for example, define a beige color space based on the histogram of each candidate's chroma ******, and a complexion range is determined, The method (JP,6-309433,A) and two or more face templates which make this complexion range a face area are prepared, After performing template matching of this face template and picture and extracting a face area candidate, extracting a face area from a picture by the method (JP,8-63597,A) of extracting a face area based on the beige distribution in a face area candidate etc., and performing image processing is proposed.

[0003]

[Problem(s) to be Solved by the Invention]However, the method indicated to above-mentioned JP,6-309433,A extracts the field in the beige space appointed beforehand as a complexion range. Therefore, since the beige concentration in a face picture continues broadly and is distributed if the contrast of a face picture is large, a possibility that the field which has the flesh color which is not contained in the defined beige space exists in a face area becomes high, and, as a result, all the fields of a face may be unable to be extracted. When the color of the background of a face is included in the defined beige space, a background will also be extracted with a face picture. On the other hand, the method indicated to above-mentioned JP,8-63597,A, When extracting a face area from the face area candidate by whom what can appoint the field of a certain amount of face by template matching using a face template was extracted based on beige distribution, the same problem as the method indicated to above-mentioned JP,6-309433,A arises.

[0004]This invention is made in view of the above-mentioned situation, and the contrast of the face contained in a face picture is taken into consideration, A matching method and a device which can acquire the information for extracting a face area appropriately, It aims at providing the recording medium which recorded the program for making a computer perform this matching method, the image processing method using a device, a device, a matching method, and an image processing method and in which computer reading is possible.

[0005]

[Means for Solving the Problem]While a matching method by this invention contains an outline of a face, and component parts of a face, Template matching which asks for

a matching degree of several face templates which differ in the direction of a light source irradiated by direction of a kind of face and a face and face at least, and a face picture containing a person's face is performed, A face template with this highest matching degree is determined, and information about the direction of a light source irradiated by direction of a face and this face in a face area where this matching degree contains a face on said face picture based on the highest face template is acquired.

[0006]Here, a "face template" contains component parts of faces, such as an outline of a face, eyes, a mouth, a nose, and an ear, about human being's face, and is obtained by changing at least the direction of a light source irradiated by direction of a kind of face and a face, and face. In a "face template" in this invention, when direction of a face changes, shape of an outline of a face differs from a locating position of component parts of a face. When the direction of a light source changes, concentration distribution of a field surrounded by outline of a face differs. For example, if the direction of a light source is a transverse plane of a face, concentration distribution will become uniform, but if the direction of a light source is right-hand side toward a template, it will be bright in right-hand side of a field surrounded by outline of a face, and left-hand side will serve as dark concentration distribution. As this "face template", a face may be expressed in three dimensions or it may express in two dimensions. As "a kind of face", an adult, a child, a woman, a male, yellow-skinned races, the white races, or a black race is mentioned. In addition to direction of a kind of face and a face, and the direction of a light source, a face template from which size of a face differs may be used.

[0007]Direction of a face can be known if a position of component parts of faces, such as shape of an outline of a face, eyes, and a nose, is known. Therefore, "information about direction of a face" means information about a position of contour shape of a face in a face template with the highest matching degree, and component parts of a face.

[0008]When the direction of a light source with which a face is irradiated is changed, distribution of a luminosity in a face will be changed variously and, as a result, concentration distribution of a face will be changed variously. Therefore, "information about the direction of a light source" means information about concentration distribution of a face area in a face template with the highest matching degree.

[0009]In a matching method by this invention, it is preferred to set up a field of a prescribed range which includes said face area in said face picture as a face area candidate, and to perform said template matching in this face area candidate.

[0010]Here, "a field of a prescribed range including a face area" may be set up by displaying a face picture on a displaying means of a monitor etc., and surrounding a face area in fields, such as a rectangle and a round shape, and may be set up by dividing a face picture into two or more fields beforehand, and extracting a field including a face area from a divided field.

[0011]In a matching method by this invention, said two or more face templates may be created beforehand.

[0012]It creates by changing direction of a face in two or more standard templates beforehand created in said two or more face templates according to a kind of said face, and the direction of a light source, it may be made to perform said template matching, acquiring a face template by which direction of this face and the direction of a light source were changed.

[0013]In a matching method by this invention, it is preferred to perform said template matching by asking for a matching degree hierarchical about said two or more face templates further again.

[0014]Here, "it asks for a matching degree hierarchical" fixes two elements (for example, direction of a face and the direction of a light source) among three elements of direction of a kind of face and a face, and the direction of a light source, makes one element (kind of face) a variable, and means performing template matching by changing only one element. [it] [it] For example, when one element made into a variable is made into a kind of face, a kind of face is determined by performing template matching about a kind of face first, and asking for a template with the highest matching degree. Subsequently, a kind of face and the direction of a face are determined by fixing a kind of face, performing template matching by making other one element (for example, direction of a face) into a variable, and asking for a template with the highest matching degree. And a kind of face in a face picture, the direction of a face, and the direction of a light source are determined by fixing a kind of face, and direction of a face, performing template matching by making one element (the direction of a light source) of further others into a variable, and asking for a template with the highest matching degree.

[0015]Based on information about direction of said face and the direction of a light source which were acquired by a matching method by this invention, an image processing method by this invention, Beige concentration distribution in said face area is searched for, beige space in said face picture is defined based on this concentration distribution, and a field corresponding to said beige space in said face picture is extracted as said face area.

[0016]Here, saying ", based on information about direction of a face and the direction of a light source, beige concentration distribution in a face area is searched for." An outline of a face area is presumed from information about direction of a face, and it says acquiring distribution of a high-density area in an outline of a face area, and a low-density area from information about a position of component parts of a face in information about direction of a face, and the direction of a light source.
[0017]It says ["which defines beige space based on concentration distribution"] appointing beige space at all the beige fields of a high-density area and a low-density area which exist all over a face area based on concentration distribution being included.
[0018]In an image processing method by this invention, it is preferred to perform predetermined image processing to said complexion range.
[0019]Here, as "image processing", processing of versatility, such as a color conversion process which considers a complexion range as a request and which is changed beige, gray-scale-conversion processing which changes gradation of a face area, and sharpness emphasis processing, can be used.
[0020]This invention is characterized by a matching device comprising the following. While an outline of a face and component parts of a face are included, template matching which asks for a matching degree of several face templates which differ in the direction of a light source irradiated by direction of a kind of face and a face and face at least, and a face picture containing a person's face is performed, A template matching means which determines a face template with this highest matching degree. An information acquisition means which acquires information about the direction of a light source irradiated by direction of a face and this face in a face area where this matching degree contains a face on said face picture based on the highest face template.

[0021]In a matching device by this invention, it has further an area setting means which sets up a field of a prescribed range which includes said face area in said face picture as a face area candidate, and, as for said template matching means, it is preferred that it is a means to perform said template matching in said face area candidate.
[0022]It may be made to have further a template memory measure which memorizes said two or more face templates in a matching device by this invention.
[0023]In a matching device by this invention, A standard template memory measure which memorizes two or more standard templates beforehand created according to a

kind of said face, it has further a template preparing means which creates said two or more face templates by changing direction of a face in said two or more standard templates, and the direction of a light source, It is good also as a means to perform said template matching, acquiring a face template from which direction of said face created by this template preparing means and the direction of said light source differ said template matching means.

[0024]As for said template matching means, in a matching device by this invention, it is preferred that it is a means to perform said template matching by asking for a matching degree hierarchical about said two or more face templates further again.

[0025]This invention is characterized by an image processing device comprising the following.

A means to search for beige concentration distribution in said face area based on information about direction of said face and the direction of a light source which were acquired by a matching device by this invention.

A means to define beige space in said face picture based on this concentration distribution.

A means to extract a field corresponding to said beige space in said face picture as said face area.

[0026]In an image processing device by this invention, it is preferred to have further a means to perform predetermined image processing to said complexion range.

[0027]A matching method and an image processing method by this invention may be recorded on a recording medium in which computer reading is possible as a program for performing a computer, and may be provided.

[0028]

[Effect of the Invention]According to the matching method and device by this invention, template matching of two or more face templates and a face picture is performed, The face area and the face template with the highest matching degree which are contained in a face picture are determined, and the information about the direction of the light source irradiated by the direction of a face and face in the face area on a face picture is acquired based on this face template. The position of the shape of the outline of a face and the component parts of a face can be known from the information about direction of a face here, and the concentration distribution of the face area changed according to the direction of the light source irradiated by the face from the information about the direction of a light source can be known. Therefore, processing of versatility, such as extraction of a complexion range and

extraction of the component parts of a face, can be made easy to perform by using the information about direction of a face and the direction of a light source.

[0029]As compared with the case where template matching is performed in the whole face picture, the calculation time for matching can be shortened by setting up the field of the prescribed range which includes a face area in a face picture as a face area candidate, and performing template matching in this face area candidate.

[0030]Template matching can be performed only by using each face template one by one, without modifying a face template in any way by creating two or more face templates beforehand.

[0031]By performing template matching, creating two or more face templates and changing direction of a face and the direction of a light source by changing further again direction of the face in the standard template created beforehand, and the direction of a light source, The number of the templates to save can be lessened and the capacity of the memory measure which memorizes a template by this can be reduced.

[0032]Since it becomes unnecessary to perform template matching about no face templates by asking for a matching degree hierarchical, the operation for template matching can be performed at high speed.

[0033]In the image processing method and device by this invention, the beige concentration distribution in the face area in a face picture is searched for based on the information about the direction of a face and the direction of a light source which were extracted by the matching method and device by this invention. That is, the outline of a face area is presumed from the information about direction of a face, distribution of the high-density area in the outline of a face area and a low-density area is acquired, and this is obtained from the information about the position of the component parts of faces, such as a nose in the information about direction of a face, and the direction of a light source as beige concentration distribution. It is the information as which a high-density area and a low-density area express how it is distributed and the contrast of the field of a face is formed, and beige space is defined as including all the beige fields of the high-density area and low-density area which exist all over a face area based on this concentration distribution. [in / in this concentration distribution / a face area] For this reason, even if the contrast of a face area is large, beige space can be defined as extracting all the flesh colors of a face area, and thereby, a complexion range can be correctly extracted from a face picture.

[0034]Image processing which considers the face area in a face picture as a request

should be performed by performing image processing to the extracted complexion range.

[0035]

[Embodiment of the Invention]With reference to drawings, the embodiment of this invention is described below.

[0036]Drawing 1 is a schematic block diagram showing the composition of the image processing device which applied the matching device by the embodiment of this invention. As shown in drawing 1, the image processing device by this embodiment is provided with the following.

It is what processes to the image data S0 showing the picture containing a person's face which was picturized with the digital camera or was read with the scanner, and obtains the processed image data S1. The reading means 1 which reads the image data S0 which reads the image data S0 from the media on which the image data S0 was recorded, or was transmitted via the network.

A face extraction means 2 to extract a person's face from the picture expressed by the read image data S0.

The image processing means 3 which performs image processing to the image data S0, and obtains the processed image data S1.

The input means 6 which consists of the output means 4 which outputs the processed image data S1 to a printer, a network, a recording medium, a monitor, etc., the monitor 5 which displays image data S0 grade, a keyboard for performing various inputs to the face extraction means 2, the image processing means 3, and the output means 4, a mouse, etc.

[0037]The face extraction means 2 is provided with the following.

A territorial extension means 11 to specify the face area candidate F who mentions later in the picture expressed by the image data S0.

The area extraction means 12 which extracts the face area candidate F specified in the territorial extension means 11.

The template memory measure 13 which memorized template data TD showing two or more templates T.

The matching means 14 which performs template matching with the face area candidate F extracted in the template T and the area extraction means 12, and searches for the information I about direction of the face in the face area candidate F, and the direction of a light source, A complexion range extraction means 15 to extract the complexion range H from the face area candidate F based on the information I

searched for in the matching means 14.

[0038]The territorial extension means 11 specifies the field which contains a face as shown, for example in drawing 2 as the face area candidate F with the directions from the input means 6 to the picture (it shall express with S0 also about a picture below) S0 which displayed the image data S0 on the monitor 5, and was displayed on the monitor 5. It may not be limited to a rectangle, and the face area candidate F may be circular, or may be an ellipse form. The number which divides the picture S0 into two or more fields, and specifies each field may be given, and the face area candidate F may be specified by specifying the number of the field containing a face. For example, as shown in drawing 3, when the picture S0 is divided into the field of 5x5, the face area candidate's F number is set to 22.

[0039]It may add to the image data S0 beforehand by making into tag information the face area candidate's F information (for example, a face area candidate's position, the number of the field containing a face) which sets up the face area candidate F beforehand when the image data S0 is acquired, and was set up. Thereby, in the territorial extension means 11, even if there are no directions from the input means 6, based on the tag information of the image data S0, the picture S0 as which the face area candidate F was specified can be displayed on the monitor 5.

[0040]Although the area extraction means 12 extracts the face area candidate F specified in the territorial extension means 11, it may change some the face area candidate's F sizes specified in the territorial extension means 11 in the case of extraction so that fields other than a face area may decrease as much as possible in the face area candidate F. Although the extracted face area candidate F may be displayed on the monitor 5 by extracting the face area candidate F in the area extraction means 12, as shown in drawing 2, the face area candidate's F boundary may be displayed on the picture S0.

[0041]The size and template data TD showing several templates T which shall be different in the direction of the light source which it is suitable and is irradiated are created and memorized with an on-the-spot photo or computer graphics about two or more kinds of faces by the template memory measure 13. It is more desirable in order that the template T may not receive the influence by blur at the time of a noise or photography, if template data TD is created with computer graphics here. The component parts of faces, such as an outline of a face and eyes, a nose, and a supercilium, according to the kind of face, a size, and direction are contained in the template T.

[0042]Here, as a kind of face, an adult, a child, a baby, an old man, a woman, a male, yellow-skinned races, the white races, or a black race is mentioned. In order to differ direction of a face, a face makes 0 times the state where it turned to the transverse plane, changes the outline of a face, and arrangement of component parts according to direction of a face which is different every 15 degrees to 0 to 360 degrees, and should just consider it as the template T, for example. In order to differ the direction of a light source, a light source makes 0 times the state of being in the transverse plane of a face, and should just make the template T the picture of the face in the state where it irradiated with light towards the face from a direction which is different every 15 degrees in **90 degrees about a total of four directions of four directions and an oblique direction. Template data TD may be created without taking the size of a face into consideration. In this case, in the matching means 14 mentioned later, the face area candidate F and the template T will be normalized, and matching will be performed.

[0043]As for template data TD, it is preferred to hierarchize and to memorize to the template memory measure 13. For example, it is preferred to match with the hierarchy of the low rank a baby's face the face of the baby from whom direction of a face differs, and to match with the hierarchy of the low rank in direction of the face of further each the face of the baby from whom the position of the shadow on a face, i.e., the position of a light source, differs, as shown in drawing 4. Thus, after the kind of face is first determined by hierarchizing and memorizing template data TD, template matching can be performed hierarchical so that the direction of a face according to the kind may be determined and the direction of the source of crepuscular rays may be determined further. Therefore, as compared with the case where template matching is performed using all the templates T, template matching of the face area candidate F and the template T in the matching means 14 can be performed efficiently.

[0044]The on-the-spot photo or the three-dimensional geometric model of computer graphics showing two or more kinds of faces may be memorized as a template data TD. Drawing 5 is a figure showing template data TD showing the three-dimensional geometric model of a male face. Thus, when template data TD is made into a three-dimensional geometric model, in the matching means 4 which changes and mentions later various the directions of the light source which displays a three-dimensional geometric model on the monitor 5, and in which the input means 6 is suitable and a face is irradiated, template matching with the face area candidate F can be performed. Thus, by making template data TD into a three-dimensional geometric model, changing direction of the face in the template T expressed by this

template data TD, and the direction of a light source, and performing template matching with the face area candidate F. Template data TD memorized to the template memory measure 13 can be lessened, and, thereby, the capacity of the template memory measure 13 can be reduced.

[0045]The direction of the light source of a face which it is suitable and is irradiated can be changed hierarchical also in this case, template matching can be performed, and, thereby, template matching with the template T can be efficiently performed with the face area candidate F.

[0046]The template T binary-ized as a template data TD may be expressed.

[0047]If the data showing the face area candidate F extracted in the area extraction means 12 is inputted, the matching means 14 will begin to read template data TD one by one from the template memory measure 13, and will perform template matching with the template T with the face area candidate F. The face area candidate F and the template T are binary-ized, and, specifically, it asks for a matching degree with the face area candidate F and the template T which were binary-ized. When the template T is binary-ized, the template T is used as it is. And a matching degree asks as the information I showing direction of a face [in / for direction of the face in the template T used as the maximum and the direction of a light source / the face area candidate F], and the direction of a light source. If F' and the binary-ized data of the template T are specifically made into TD' for the data in the face area candidate F who binary-ized, whenever it changes the position and kind of template T, as shown in the following formula (1), matching degree M of data F' and data TD' will be computed.

[0048]

$$M=(\text{sigma}|Fij'-TDij'|)/n \quad (1)$$

however, the pixel number of the picture expressed by pixel value n:data Fij' or data TDij' of the picture expressed by pixel value TDij':data F' of the picture expressed by Fij':data F', and corresponding data TD' — and, It asks as the information I as which computed matching degree M expresses direction of a face [in / for direction of the face in the template T used as the maximum and the direction of a light source / the face area candidate F], and the direction of a light source. Template matching may be performed without binary-izing the template T and the face area candidate F.

[0049]Here, direction of a face can be known if the position of the component parts of faces, such as shape of the outline of a face, eyes, and a nose, is known. Therefore, the information about direction of a face means the information about the position of the component parts of faces, such as contour shape of the face in the template T with the highest matching degree, eyes, and a nose.

[0050]When the direction of the light source with which a face is irradiated is changed, distribution of the luminosity in a face will be changed variously and, as a result, the concentration distribution of a face will be changed variously. Therefore, the information about the direction of a light source means the information about the concentration distribution of the face in the template T with the highest matching degree.

[0051]As template data TD shows drawing 4 the template memory measure 13, when hierarchizing, after matching of the kind of face, What is necessary is to match only direction of a face in the low order hierarchy of the face of the matched kind, and after matching of direction of a face should match only about the direction of a light source in the low order hierarchy of direction of a face further.

[0052]By inputting beforehand the kind (for example, it is by a baby's face which is a female face) of face contained in the picture S0 at the time of the territorial extension in the territorial extension means 11, In the matching means 14, the template T showing the inputted face of a kind can be preferentially used for matching, and this can also perform template matching efficiently.

[0053]Log-Polar conversion of the face area candidate F and the template T may be carried out, and template matching may be performed. Since human being's face is making circularly near shape, while it makes the center of a face picture a pole, here the face picture with which light was irradiated from the right 90 degree direction as shown, for example in drawing 6, If Log-Polar conversion is carried out on the basis of the Y-axis in drawing 6, on polar coordinates, the outline of a face will extend to an abbreviated horizontal direction, as shown in drawing 7. Therefore, template matching can be made easy to perform as compared with the case where template matching of the fields which have circularly near shape by carrying out Log-Polar conversion of the face area candidate F and the template T is carried out.

[0054]Based on the information I showing the direction and the direction of a light source of a face in the face area candidate F obtained in the matching means 14, the complexion range extraction means 15, Area division of the face area candidate F is carried out to a bright field, i.e., a low-density area, and a dark field, i.e., a high-density area, beige space is defined for every field, and a complexion range is extracted. Extraction of this complexion range H is performed as follows. First, the outline of the face in the face area candidate F can be known from the information about direction of a face, and it can know, distribution, i.e., the concentration distribution, of the bright field in the field surrounded by the outline from the information which expresses the direction of a light source further, and a dark field. Although the position of the

component parts of a face can be known from the information about direction of a face in this case, based on the information especially about the position of a nose and eyes, the position of the cheek under the nose and eyes which become brighter than other fields in a face can be known. And beige space is defined based on the position of concentration distribution and a nose, and a cheek, and the complexion range H is extracted.

[0055]As specifically shown in drawing 6, when light is irradiated from the right-hand side of the face which turned to the transverse plane, although it is bright in the field in the right half of a face (it is considered as a right area below), the field (it is considered as a left area below) of a left half will become dark. Since the nose and the cheek have projected in human being's face, in a right area, the right-hand side and the cheek of a nose become brighter than other fields. Also in a left area, the portions of a nose and a cheek become brighter than other fields.

[0056]Therefore, about a right area, beige space is defined as including the brightest portion, i.e., the right-hand side of a nose and the portion of a cheek, and the field in the right half of a face is extracted. On the other hand, beige space is defined as including the left-hand side of a nose, and the portion of a cheek also about the left half of a face, and the field in the left half of a face is extracted.

[0057]The image processing means 3 performs image processing, such as gradation processing, a color conversion process, a sharpness process, to the image data S0 of this complexion range H, and obtains the processed image data S1 so that it may become the concentration and the color which the extracted complexion range H considers as a request. Image processing may be performed about fields other than the complexion range H. Here, as a sharpness process, according to the size of the complexion range H, i.e., the size of a face, when a face is large, the grade of sharpness emphasis can be weakened, and it can process so that the grade of sharpness emphasis may be enlarged, when a face is small.

[0058]Subsequently, operation of this embodiment is explained. Drawing 8 is a flow chart which shows operation of this embodiment. First, the image data S0 is read in the reading means 1 (Step S1), and it is inputted into the face area extraction means 2. The image data S0 is displayed on the monitor 5 (Step S2), and the face area candidate F is specified by the input from the input means 6 (Step S3). And the face area candidate F is extracted in the area extraction means 12 (step S4). The extracted face area candidate F is inputted into the matching means 14, and template matching of the template T and the face area candidate F to whom it is expressed by template data TD is performed using template data TD memorized by the template

memory measure 13 here (Step S5). And an end of template matching will generate the information I which expresses direction of a face and the direction of a light source based on the template T with the largest matching degree (Step S6).

[0059]Based on the information I, the complexion range extraction means 15 extracts the complexion range H from the face area candidate F, as mentioned above (Step S7). And image processing, such as gradation processing, a color conversion process, and a sharpness process, is performed to the complexion range H in the picture expressed by the image data S0 in the image processing means 3, and the processed image data S1 is obtained (Step S8). And the processed image data S1 is outputted in the output means 4 (step S9), and ends processing.

[0060]Having acquired the information I which carries out template matching of the face area candidate F by two or more templates T, and expresses direction of the face in the face area candidate F, and the direction of a light source in this embodiment Thus, a sake, The position of the contour shape of a face and the component parts of a face can be known from the information about direction of a face, and the concentration distribution of the face area candidate F changed according to the direction of the light irradiated by the face from the information about the direction of a light source can be known. And among the information I, the outline of a face area is presumed from the information about direction of a face, and the concentration distribution in the outline of a face is acquired from the information about the position of the component parts of faces, such as a nose in the information about direction of a face, and the direction of a light source. Therefore, by defining beige space as including all the beige fields of the high-density area and low-density area which exist all over the field in the outline of the face in the face area candidate F based on this concentration distribution, Beige space can be defined as extracting all the face area candidate's F flesh colors as the contrast of a face area is large, and, thereby, the complexion range H can be extracted correctly.

[0061]That the field of the prescribed range which contains a face in the territorial extension means 11 is set up as the face area candidate F, and it was made to perform template matching in this set-up face area candidate F A sake, The calculation time for matching can be shortened as compared with the case where template matching is performed in the whole face picture.

[0062]Although the information about direction of a face and the information about the direction of a light source are acquired as the information I and the complexion range H is extracted in the above-mentioned embodiment based on these, Based on the information I, the position of the component parts of faces, such as eyes and a

nose, can be known from the face area candidate F, and, thereby, the component parts of the face from the face area candidate F can be simply extracted using the information I.

[Translation done.]

TECHNICAL FIELD

[Field of the Invention]A matching method and a device which perform template matching of the picture and template in which this invention contains a person's face, It is related with the recording medium which recorded the program for making a computer perform the image processing method, the device, matching method, and image processing method using these methods and devices and in which computer reading is possible.

PRIOR ART

[Description of the Prior Art]In pictures, such as a photograph obtained by photoing a person image using a negative film, a reversal film, etc., the part which attracts attention most is a person's face. Therefore, in order to improve the vanity of a picture, it is necessary to perform image processing to a picture so that it may become a color with a person's proper face, concentration, and gradation. In order to perform image processing so that it may become a color with a person's proper face, concentration, and gradation on the other hand, it is necessary to extract a person's face area from a picture appropriately. For this reason, extract the candidate of a complexion range out of the picture which includes a person, for example, define a beige color space based on the histogram of each candidate's chroma ******, and a complexion range is determined, The method (JP,6-309433,A) and two or more face templates which make this complexion range a face area are prepared, After performing template matching of this face template and picture and extracting a face area candidate, extracting a face area from a picture by the method (JP,8-63597,A) of extracting a face area based on the beige distribution in a face area candidate etc., and performing image processing is proposed.

[Translation done.]

EFFECT OF THE INVENTION

[Effect of the Invention]According to the matching method and device by this invention, template matching of two or more face templates and a face picture is performed. The face area and the face template with the highest matching degree which are contained in a face picture are determined, and the information about the direction of the light source irradiated by the direction of a face and face in the face area on a face picture is acquired based on this face template. The position of the shape of the outline of a face and the component parts of a face can be known from the information about direction of a face here, and the concentration distribution of the face area changed according to the direction of the light source irradiated by the face from the information about the direction of a light source can be known. Therefore, processing of versatility, such as extraction of a complexion range and extraction of the component parts of a face, can be made easy to perform by using the information about direction of a face and the direction of a light source.

[0029]As compared with the case where template matching is performed in the whole face picture, the calculation time for matching can be shortened by setting up the field of the prescribed range which includes a face area in a face picture as a face area candidate, and performing template matching in this face area candidate.

[0030]Template matching can be performed only by using each face template one by one, without modifying a face template in any way by creating two or more face templates beforehand.

[0031]By performing template matching, creating two or more face templates and changing direction of a face and the direction of a light source by changing further again direction of the face in the standard template created beforehand, and the direction of a light source, The number of the templates to save can be lessened and the capacity of the memory measure which memorizes a template by this can be reduced.

[0032]Since it becomes unnecessary to perform template matching about no face templates by asking for a matching degree hierarchical, the operation for template matching can be performed at high speed.

[0033]In the image processing method and device by this invention, the beige

concentration distribution in the face area in a face picture is searched for based on the information about the direction of a face and the direction of a light source which were extracted by the matching method and device by this invention. That is, the outline of a face area is presumed from the information about direction of a face, distribution of the high-density area in the outline of a face area and a low-density area is acquired, and this is obtained from the information about the position of the component parts of faces, such as a nose in the information about direction of a face, and the direction of a light source as beige concentration distribution. This concentration distribution is the information showing how for the high-density area and low-density area in a face area to be distributed, and to form the contrast of the field of a face.

Beige space is defined as including all the beige fields of the high-density area and low-density area which exist all over a face area based on this concentration distribution.

For this reason, even if the contrast of a face area is large, beige space can be defined as extracting all the flesh colors of a face area, and thereby, a complexion range can be correctly extracted from a face picture.

[0034]Image processing which considers the face area in a face picture as a request should be performed by performing image processing to the extracted complexion range.

[0035]

[Embodiment of the Invention]With reference to drawings, the embodiment of this invention is described below.

[0036]Drawing 1 is a schematic block diagram showing the composition of the image processing device which applied the matching device by the embodiment of this invention. As shown in drawing 1, the image processing device by this embodiment processes to the image data S0 showing the picture containing a person's face which was picturized with the digital camera or was read with the scanner, and obtains the processed image data S1.

The reading means 1 which reads the image data S0 which reads the image data S0 from the media on which the image data S0 was recorded, or was transmitted via the network, A face extraction means 2 to extract a person's face from the picture expressed by the read image data S0, The image processing means 3 which performs image processing to the image data S0, and obtains the processed image data S1, The output means 4 which outputs the processed image data S1 to a printer, a network, a recording medium, a monitor, etc., It has the input means 6 which consists of the

monitor 5 which displays image data S0 grade, a keyboard for performing various inputs to the face extraction means 2, the image processing means 3, and the output means 4, a mouse, etc.

[0037]A territorial extension means 11 to specify the face area candidate F who mentions the face extraction means 2 later in the picture expressed by the image data S0, The area extraction means 12 which extracts the face area candidate F specified in the territorial extension means 11, The template memory measure 13 which memorized template data TD showing two or more templates T, The matching means 14 which performs template matching with the face area candidate F extracted in the template T and the area extraction means 12, and searches for the information I about direction of the face in the face area candidate F, and the direction of a light source, Based on the information I searched for in the matching means 14, it has a complexion range extraction means 15 to extract the complexion range H from the face area candidate F.

[0038]The territorial extension means 11 specifies the field which contains a face as shown, for example in drawing 2 as the face area candidate F with the directions from the input means 6 to the picture (it shall express with S0 also about a picture below) S0 which displayed the image data S0 on the monitor 5, and was displayed on the monitor 5. It may not be limited to a rectangle, and the face area candidate F may be circular, or may be an ellipse form. The number which divides the picture S0 into two or more fields, and specifies each field may be given, and the face area candidate F may be specified by specifying the number of the field containing a face. For example, as shown in drawing 3, when the picture S0 is divided into the field of 5x5, the face area candidate's F number is set to 22.

[0039]It may add to the image data S0 beforehand by making into tag information the face area candidate's F information (for example, a face area candidate's position, the number of the field containing a face) which sets up the face area candidate F beforehand when the image data S0 is acquired, and was set up. Thereby, in the territorial extension means 11, even if there are no directions from the input means 6, based on the tag information of the image data S0, the picture S0 as which the face area candidate F was specified can be displayed on the monitor 5.

[0040]Although the area extraction means 12 extracts the face area candidate F specified in the territorial extension means 11, it may change some the face area candidate's F sizes specified in the territorial extension means 11 in the case of extraction so that fields other than a face area may decrease as much as possible in

the face area candidate F. Although the extracted face area candidate F may be displayed on the monitor 5 by extracting the face area candidate F in the area extraction means 12, as shown in drawing 2, the face area candidate's F boundary may be displayed on the picture S0.

[0041]The size and template data TD showing several templates T which shall be different in the direction of the light source which it is suitable and is irradiated are created and memorized with an on-the-spot photo or computer graphics about two or more kinds of faces by the template memory measure 13. It is more desirable in order that the template T may not receive the influence by blur at the time of a noise or photography, if template data TD is created with computer graphics here. The component parts of faces, such as an outline of a face and eyes, a nose, and a supercilium, according to the kind of face, a size, and direction are contained in the template T.

[0042]Here, as a kind of face, an adult, a child, a baby, an old man, a woman, a male, yellow-skinned races, the white races, or a black race is mentioned. In order to differ direction of a face, a face makes 0 times the state where it turned to the transverse plane, changes the outline of a face, and arrangement of component parts according to direction of a face which is different every 15 degrees to 0 to 360 degrees, and should just consider it as the template T, for example. In order to differ the direction of a light source, a light source makes 0 times the state of being in the transverse plane of a face, and should just make the template T the picture of the face in the state where it irradiated with light towards the face from a direction which is different every 15 degrees in **90 degrees about a total of four directions of four directions and an oblique direction. Template data TD may be created without taking the size of a face into consideration. In this case, in the matching means 14 mentioned later, the face area candidate F and the template T will be normalized, and matching will be performed.

[0043]As for template data TD, it is preferred to hierarchize and to memorize to the template memory measure 13. For example, it is preferred to match with the hierarchy of the low rank a baby's face the face of the baby from whom direction of a face differs, and to match with the hierarchy of the low rank in direction of the face of further each the face of the baby from whom the position of the shadow on a face, i.e., the position of a light source, differs, as shown in drawing 4. Thus, after the kind of face is first determined by hierarchizing and memorizing template data TD, template matching can be performed hierarchical so that the direction of a face according to the kind may be determined and the direction of the source of crepuscular rays may

be determined further. Therefore, as compared with the case where template matching is performed using all the templates T, template matching of the face area candidate F and the template T in the matching means 14 can be performed efficiently.
[0044]The on-the-spot photo or the three-dimensional geometric model of computer graphics showing two or more kinds of faces may be memorized as a template data TD. Drawing 5 is a figure showing template data TD showing the three-dimensional geometric model of a male face. Thus, when template data TD is made into a three-dimensional geometric model, In the matching means 4 which changes and mentions later various the directions of the light source which displays a three-dimensional geometric model on the monitor 5, and in which the input means 6 is suitable and a face is irradiated, template matching with the face area candidate F can be performed. Thus, by making template data TD into a three-dimensional geometric model, changing direction of the face in the template T expressed by this template data TD, and the direction of a light source, and performing template matching with the face area candidate F, Template data TD memorized to the template memory measure 13 can be lessened, and, thereby, the capacity of the template memory measure 13 can be reduced.
[0045]The direction of the light source of a face which it is suitable and is irradiated can be changed hierarchical also in this case, template matching can be performed, and, thereby, template matching with the template T can be efficiently performed with the face area candidate F.
[0046]The template T binary-ized as a template data TD may be expressed.
[0047]If the data showing the face area candidate F extracted in the area extraction means 12 is inputted, the matching means 14 will begin to read template data TD one by one from the template memory measure 13, and will perform template matching with the template T with the face area candidate F. The face area candidate F and the template T are binary-ized, and, specifically, it asks for a matching degree with the face area candidate F and the template T which were binary-ized. When the template T is binary-ized, the template T is used as it is. And a matching degree asks as the information I showing direction of a face [in / for direction of the face in the template T used as the maximum and the direction of a light source / the face area candidate F], and the direction of a light source. If F' and the binary-ized data of the template T are specifically made into TD' for the data in the face area candidate F who binary-ized, whenever it changes the position and kind of template T, as shown in the following formula (1), matching degree M of data F' and data TD' will be computed.
[0048]

M=(sigma|Fij '−TDij'|)/n (1)

however, the pixel number of the picture expressed by pixel value n:data Fij' or data TDij' of the picture expressed by pixel value TDij':data F' of the picture expressed by Fij':data F', and corresponding data TD' −− and, It asks as the information I as which computed matching degree M expresses direction of a face [in / for direction of the face in the template T used as the maximum and the direction of a light source / the face area candidate F], and the direction of a light source. Template matching may be performed without binary−izing the template T and the face area candidate F.

[0049]Here, direction of a face can be known if the position of the component parts of faces, such as shape of the outline of a face, eyes, and a nose, is known. Therefore, the information about direction of a face means the information about the position of the component parts of faces, such as contour shape of the face in the template T with the highest matching degree, eyes, and a nose.

[0050]When the direction of the light source with which a face is irradiated is changed, distribution of the luminosity in a face will be changed variously and, as a result, the concentration distribution of a face will be changed variously. Therefore, the information about the direction of a light source means the information about the concentration distribution of the face in the template T with the highest matching degree.

[0051]As template data TD shows drawing 4 the template memory measure 13, when hierarchizing, after matching of the kind of face, What is necessary is to match only direction of a face in the low order hierarchy of the face of the matched kind, and after matching of direction of a face should match only about the direction of a light source in the low order hierarchy of direction of a face further.

[0052]By inputting beforehand the kind (for example, it is by a baby's face which is a female face) of face contained in the picture S0 at the time of the territorial extension in the territorial extension means 11, In the matching means 14, the template T showing the inputted face of a kind can be preferentially used for matching, and this can also perform template matching efficiently.

[0053]Log−Polar conversion of the face area candidate F and the template T may be carried out, and template matching may be performed. Since human being's face is making circularly near shape, while it makes the center of a face picture a pole, here the face picture with which light was irradiated from the right 90 degree direction as shown, for example in drawing 6, If Log−Polar conversion is carried out on the basis of the Y−axis in drawing 6, on polar coordinates, the outline of a face will extend to an abbreviated horizontal direction, as shown in drawing 7. Therefore, template matching

can be made easy to perform as compared with the case where template matching of the fields which have circularly near shape by carrying out Log-Polar conversion of the face area candidate F and the template T is carried out.

[0054]Based on the information 1 showing the direction and the direction of a light source of a face in the face area candidate F obtained in the matching means 14, the complexion range extraction means 15, Area division of the face area candidate F is carried out to a bright field, i.e., a low-density area, and a dark field, i.e., a high-density area, beige space is defined for every field, and a complexion range is extracted. Extraction of this complexion range H is performed as follows. First, the outline of the face in the face area candidate F can be known from the information about direction of a face, and it can know, distribution, i.e., the concentration distribution, of the bright field in the field surrounded by the outline from the information which expresses the direction of a light source further, and a dark field. Although the position of the component parts of a face can be known from the information about direction of a face in this case, based on the information especially about the position of a nose and eyes, the position of the cheek under the nose and eyes which become brighter than other fields in a face can be known. And beige space is defined based on the position of concentration distribution and a nose, and a cheek, and the complexion range H is extracted.

[0055]As specifically shown in drawing 6, when light is irradiated from the right-hand side of the face which turned to the transverse plane, although it is bright in the field in the right half of a face (it is considered as a right area below), the field (it is considered as a left area below) of a left half will become dark. Since the nose and the cheek have projected in human being's face, In a right area, the right-hand side and the cheek of a nose become brighter than other fields. Also in a left area, the portions of a nose and a cheek become brighter than other fields.

[0056]Therefore, about a right area, beige space is defined as including the brightest portion, i.e., the right-hand side of a nose and the portion of a cheek, and the field in the right half of a face is extracted. On the other hand, beige space is defined as including the left-hand side of a nose, and the portion of a cheek also about the left half of a face, and the field in the left half of a face is extracted.

[0057]The image processing means 3 performs image processing, such as gradation processing, a color conversion process, a sharpness process, to the image data S0 of this complexion range H, and obtains the processed image data S1 so that it may become the concentration and the color which the extracted complexion range H considers as a request. Image processing may be performed about fields other than

the complexion range H. Here, as a sharpness process, according to the size of the complexion range H, i.e., the size of a face, when a face is large, the grade of sharpness emphasis can be weakened, and it can process so that the grade of sharpness emphasis may be enlarged, when a face is small.

[0058]Subsequently, operation of this embodiment is explained. Drawing 8 is a flow chart which shows operation of this embodiment. First, the image data S0 is read in the reading means 1 (Step S1), and it is inputted into the face area extraction means 2. The image data S0 is displayed on the monitor 5 (Step S2), and the face area candidate F is specified by the input from the input means 6 (Step S3). And the face area candidate F is extracted in the area extraction means 12 (step S4). The extracted face area candidate F is inputted into the matching means 14, and template matching of the template T and the face area candidate F to whom it is expressed by template data TD is performed using template data TD memorized by the template memory measure 13 here (Step S5). And an end of template matching will generate the information I which expresses direction of a face and the direction of a light source based on the template T with the largest matching degree (Step S6).

[0059]Based on the information I, the complexion range extraction means 15 extracts the complexion range H from the face area candidate F, as mentioned above (Step S7). And image processing, such as gradation processing, a color conversion process, and a sharpness process, is performed to the complexion range H in the picture expressed by the image data S0 in the image processing means 3, and the processed image data S1 is obtained (Step S8). And the processed image data S1 is outputted in the output means 4 (step S9), and ends processing.

[0060]Having acquired the information I which carries out template matching of the face area candidate F by two or more templates T, and expresses direction of the face in the face area candidate F, and the direction of a light source in this embodiment Thus, a sake, The position of the contour shape of a face and the component parts of a face can be known from the information about direction of a face, and the concentration distribution of the face area candidate F changed according to the direction of the light irradiated by the face from the information about the direction of a light source can be known. And among the information I, the outline of a face area is presumed from the information about direction of a face, and the concentration distribution in the outline of a face is acquired from the information about the position of the component parts of faces, such as a nose in the information about direction of a face, and the direction of a light source. Therefore, by defining beige space as including all the beige fields of the high-density area and low-density area which exist

all over the field in the outline of the face in the face area candidate F based on this concentration distribution, Beige space can be defined as extracting all the face area candidate's F flesh colors as the contrast of a face area is large, and, thereby, the complexion range H can be extracted correctly.

[0061]That the field of the presoribed range which contains a face in the territorial extension means 11 is set up as the face area candidate F, and it was made to perform template matching in this set-up face area candidate F A sake, The calculation time for matching can be shortened as compared with the case where template matching is performed in the whole face picture.

[0062]Although the information about direction of a face and the information about the direction of a light source are acquired as the information I and the complexion range H is extracted in the above-mentioned embodiment based on these, Based on the information I, the position of the component parts of faces, such as eyes and a nose, can be known from the face area candidate F, and, thereby, the component parts of the face from the face area candidate F can be simply extracted using the information I.

[Translation done.]
TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention]However, the method indicated to above-mentioned JP,6-309433,A extracts the field in the beige space appointed beforehand as a complexion range. Therefore, since the beige concentration in a face picture continues broadly and is distributed if the contrast of a face picture is large, a possibility that the field which has the flesh color which is not contained in the defined beige space exists in a face area becomes high, and, as a result, all the fields of a face may be unable to be extracted. When the color of the background of a face is included in the defined beige space, a background will also be extracted with a face picture. On the other hand, the method indicated to above-mentioned JP,8-63597,A, When extracting a face area from the face area candidate by whom what can appoint the field of a certain amount of face by template matching using a face template was extracted based on beige distribution, the same problem as the method indicated to above-mentioned JP,6-309433,A arises.

[0004]This invention is made in view of the above-mentioned situation, and the

contrast of the face contained in a face picture is taken into consideration, A matching method and a device which can acquire the information for extracting a face area appropriately, It aims at providing the recording medium which recorded the program for making a computer perform this matching method, the image processing method using a device, a device, a matching method, and an image processing method and in which computer reading is possible.

[Translation done.]
MEANS

[Means for Solving the Problem]While a matching method by this invention contains an outline of a face, and component parts of a face, Template matching which asks for a matching degree of several face templates which differ in the direction of a light source irradiated by direction of a kind of face and a face and face at least, and a face picture containing a person's face is performed, A face template with this highest matching degree is determined, and information about the direction of a light source irradiated by direction of a face and this face in a face area where this matching degree contains a face on said face picture based on the highest face template is acquired.

[0006]Here, a "face template" contains component parts of faces, such as an outline of a face, eyes, a mouth, a nose, and an ear, about human being's face, and is obtained by changing at least the direction of a light source irradiated by direction of a kind of face and a face, and face. In a "face template" in this invention, when direction of a face changes, shape of an outline of a face differs from a locating position of component parts of a face. When the direction of a light source changes, concentration distribution of a field surrounded by outline of a face differs. For example, if the direction of a light source is a transverse plane of a face, concentration distribution will become uniform, but if the direction of a light source is right-hand side toward a template, it will be bright in right-hand side of a field surrounded by outline of a face, and left-hand side will serve as dark concentration distribution. As this "face template", a face may be expressed in three dimensions or it may express in two dimensions. As "a kind of face", an adult, a child, a woman, a male, yellow-skinned races, the white races, or a black race is mentioned. In addition to direction of a kind of face and a face, and the direction of a light source, a face

template from which size of a face differs may be used.

[0007]Direction of a face can be known if a position of component parts of faces, such as shape of an outline of a face, eyes, and a nose, is known. Therefore, "information about direction of a face" means information about a position of contour shape of a face in a face template with the highest matching degree, and component parts of a face.

[0008]When the direction of a light source with which a face is irradiated is changed, distribution of a luminosity in a face will be changed variously and, as a result, concentration distribution of a face will be changed variously. Therefore, "information about the direction of a light source" means information about concentration distribution of a face area in a face template with the highest matching degree.

[0009]In a matching method by this invention, it is preferred to set up a field of a prescribed range which includes said face area in said face picture as a face area candidate, and to perform said template matching in this face area candidate.

[0010]Here, "a field of a prescribed range including a face area" may be set up by displaying a face picture on a displaying means of a monitor etc., and surrounding a face area in fields, such as a rectangle and a round shape, and may be set up by dividing a face picture into two or more fields beforehand, and extracting a field including a face area from a divided field.

[0011]In a matching method by this invention, said two or more face templates may be created beforehand.

[0012]It creates by changing direction of a face in two or more standard templates beforehand created in said two or more face templates according to a kind of said face, and the direction of a light source, It may be made to perform said template matching, acquiring a face template by which direction of this face and the direction of a light source were changed.

[0013]In a matching method by this invention, it is preferred to perform said template matching by asking for a matching degree hierarchical about said two or more face templates further again.

[0014]Here, "it asks for a matching degree hierarchical" fixes two elements (for example, direction of a face and the direction of a light source) among three elements of direction of a kind of face and a face, and the direction of a light source, makes one element (kind of face) a variable, and means performing template matching by changing only one element. [it] [it] For example, when one element made into a variable is made into a kind of face, a kind of face is determined by performing template matching about a kind of face first, and asking for a template with the highest

matching degree. Subsequently, a kind of face and the direction of a face are determined by fixing a kind of face, performing template matching by making other one element (for example, direction of a face) into a variable, and asking for a template with the highest matching degree. And a kind of face in a face picture, the direction of a face, and the direction of a light source are determined by fixing a kind of face, and direction of a face, performing template matching by making one element (the direction of a light source) of further others into a variable, and asking for a template with the highest matching degree.

[0015]Based on information about direction of said face and the direction of a light source which were acquired by a matching method by this invention, an image processing method by this invention, Beige concentration distribution in said face area is searched for, beige space in said face picture is defined based on this concentration distribution, and a field corresponding to said beige space in said face picture is extracted as said face area.

[0016]Here, saying ", based on information about direction of a face and the direction of a light source, beige concentration distribution in a face area is searched for." An outline of a face area is presumed from information about direction of a face, and it says acquiring distribution of a high-density area in an outline of a face area, and a low-density area from information about a position of component parts of a face in information about direction of a face, and the direction of a light source.

[0017]It says ["which defines beige space based on concentration distribution"] appointing beige space at all the beige fields of a high-density area and a low-density area which exist all over a face area based on concentration distribution being included.

[0018]In an image processing method by this invention, it is preferred to perform predetermined image processing to said complexion range.

[0019]Here, as "image processing", processing of versatility, such as a color conversion process which considers a complexion range as a request and which is changed beige, gray-scale-conversion processing which changes gradation of a face area, and sharpness emphasis processing, can be used.

[0020]This invention is characterized by a matching device comprising the following. While an outline of a face and component parts of a face are included, template matching which asks for a matching degree of several face templates which differ in the direction of a light source irradiated by direction of a kind of face and a face and face at least, and a face picture containing a person's face is performed, A template matching means which determines a face template with this highest matching degree.

An information acquisition means which acquires information about the direction of a light source irradiated by direction of a face and this face in a face area where this matching degree contains a face on said face picture based on the highest face template.

[0021]In a matching device by this invention, it has further an area setting means which sets up a field of a presoribed range which includes said face area in said face picture as a face area candidate, and, as for said template matching means, it is preferred that it is a means to perform said template matching in said face area candidate.
[0022]It may be made to have further a template memory measure which memorizes said two or more face templates in a matching device by this invention.
[0023]In a matching device by this invention, A standard template memory measure which memorizes two or more standard templates beforehand created according to a kind of said face, It has further a template preparing means which creates said two or more face templates by changing direction of a face in said two or more standard templates, and the direction of a light source, It is good also as a means to perform said template matching, acquiring a face template from which direction of said face created by this template preparing means and the direction of said light source differ said template matching means.
[0024]As for said template matching means, in a matching device by this invention, it is preferred that it is a means to perform said template matching by asking for a matching degree hierarchical about said two or more face templates further again.
[0025]This invention is characterized by an image processing device comprising the following.
A means to search for beige concentration distribution in said face area based on information about direction of said face and the direction of a light source which were acquired by a matching device by this invention.
A means to define beige space in said face picture based on this concentration distribution.
A means to extract a field corresponding to said beige space in said face picture as said face area.

[0026]In an image processing device by this invention, it is preferred to have further a means to perform predetermined image processing to said complexion range.
[0027]A matching method and an image processing method by this invention may be

recorded on a recording medium in which computer reading is possible as a program for performing a computer, and may be provided.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1]The block diagram showing the composition of the image processing device by the embodiment of this invention

[Drawing 2]The figure for explaining the face area candidate's F specification

[Drawing 3]The figure for explaining the face area candidate's F specification

[Drawing 4]The figure showing the hierarchized template

[Drawing 5]The figure showing the example of a three-dimensional template

[Drawing 6]The figure for explaining extraction of a complexion range

[Drawing 7]The figure showing the face area candidate who did Log-Polar conversion

[Drawing 8]The flow chart which shows operation of this embodiment

[Description of Notations]

1 Reading means

2 Face extraction means

3 Image processing means

4 Output means

5 Monitor

6 Input means

11 Territorial extension means

12 Area extraction means

13 Template memory measure

14 Matching means

15 Complexion range extraction means

[Translation done.]

* NOTICES *

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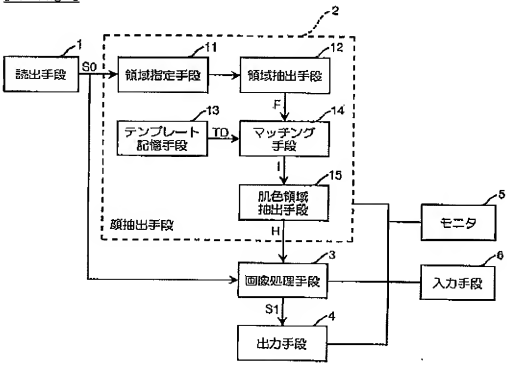
damages caused by the use of this translation.

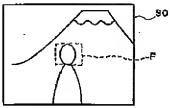
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

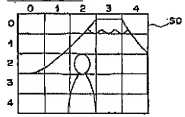
[Drawing 1]



[Drawing 2]



[Drawing 3]



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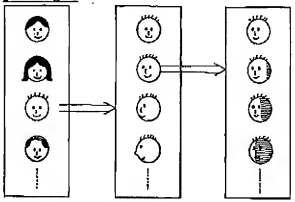
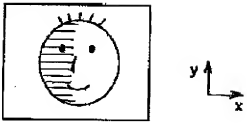
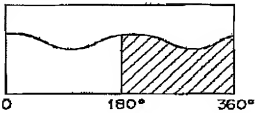


[Drawing 5]

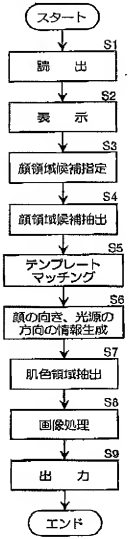
[Drawing 6]



[Drawing 7]



[Drawing 8]



[Translation done.]